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ECO-FRIENDLY AND ALTERNATIVE WEED MANAGEMENT PRACTICES IN BUCKWHEAT (*FAGOPYRUM ESCULENTUM* MOENCH.) IN RELATION TO YIELD POTENTIAL UNDER RAINFED CONDITION

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ABSTRACT

A field experiment was conducted during the year of 2011-2012 and 2012-2013 at the Instructional Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal. The experimental field was laid out in Randomized Block Design, having seven varying treatments with three replications. The treatments consisted of Dry weed biomass mulch @ 5.0 t ha^{-1}(T_1), Paddy straw mulch @ 5.0 t ha^{-1} (T_2), FYM Mulch @ 5.0 t ha^{-1} (T_3), Hoeing (Twice) 20 and 35 DAS (T_4), Hand weeding (twice) at 20 and 35 DAS (T_5), Hand weeding at 20 DAS and Hoeing at 35 DAS (T_6) and Unweeded control (T_7). The obtained results of buckwheat under seven varying ecofriendly and alternative weed management practices showed that the hoeing twice at 20 & 35 DAS appreciably reduced the total weed population per metre square and total dry weight of weeds than unweeded control plot (T_7) at all the stages of crop growth. However the values of weed control efficiency were higher in second year than first year up to 60 DAS but reverse trend was at harvest. Yield attributes and yield recorded highest in hands weeding (twice) at 20 and 35 days after sowing (DAS) followed by Hand weeding (once) at 20 DAS combined with Hoeing at 35 DAS (T_6) over unweeded control whereas FYM Mulch @ 5.0 t ha^{-1} (T_3) produces seed yield comparable to hand weeding treatment. The results showed that it is necessary to cover the soil surface with different mulching materials and manually weed control practices to achieve a good control of weeds along with enhanced yield attributes and yield.

KEYWORDS: Yields, Weeds, Organic Mulch, Hand Weeding, Hoeing

INTRODUCTION

Buckwheat (*Fagopyrum esculentum* Moench) belonging to the family Polygonaceae is a multipurpose and annual crop. It is an underutilized pseudo cereal but its grains belong to cereals because of their similar use (Campbell 1997). There are some botanical and physiological similarities between buckwheat and weeds, one of them being the ability to correct growth without the use of fertilizers (Kreft *et al.* 1996). Weeds are unwanted and undesirable plants, which compete for light, water, nutrients, carbon dioxide and space (Anderson, 1996). Weed interference is one of the most important limiting factors which decrease crop yields and consequently global food production. Weed represent about 0.1% of the world flora and in agro ecosystems, weeds and crops have coevolved together right from the prehistoric times as revealed by pollen analysis studies (Cousens and Mortimer 1995). Weed can suppress crop yield by competing for environmental resources like moisture, light and nutrients. Therefore, weed management have been a major challenge for crop producers from the start of agriculture. Weed management is to reduce the weed population to a level where their

presence has no effect on the areas of economic use. Weed management is the shifting of the crop-weed balance so that yield is not economically reduced (Altieri and Letourneau 1982). Weed management is also to be considered on the basis of its economic, ecological and sociological consequences. This means that the choice of weed control methods not only depends on technical solutions but relies also on other criteria (Shaw 1982). At the earlier times, since no synthetic chemicals were known, weed control was achieved by some methods such as hand weeding, crop rotation, polyculture and other management practices that were low input but sustainable. With the discovery of synthetic herbicides in the early 1930s, there was a shift in weeds control methods toward high input and target oriented ones (Singh et al. 2003). However, herbicide reliant weed control methods can cause high costs for crop producers due to the consumption of fossil fuels (the non-renewable energy resources) (Lybecker et al. 1988). Moreover, ground and surface water pollution by these synthetic chemicals are causes for concern (Hallberg 1989). Fast developing herbicide resistant ecotypes of weeds due to increased herbicide application are another serious threat for agriculture production (Holt and LeBaron 1990). Therefore, there is an urgent need to develop ecofriendly and alternative weed control methods for use in agro-ecosystems. Many studies have revealed that the alternative methods such as the use of cover crops, living mulches, Farm yard manure (FYM) mulch, dry weeds biomass mulch, straw mulch (paddy and wheat), competitive crop cultivars etc. can be proposed as the low cost, effective and eco-friendly practices for sustainable weed management in cropping systems. The different mulching material has significant effect on weed suppression (Shah et al. 2011). Mulching is the best way used to control weeds (Kluepfel, 2010). Considering the above mentioned reason a study on ecofriendly and alternative weed control practices was carried out under Terai region of West Bengal.

MATERIALS AND METHODS

The experiment was conducted at the Farm of Uttar Banga Krishi Viswavidyalaya, Pundibari, Cooch Behar, West Bengal during 2011-2012 and 2012-2013. The experimental field was laid out in Randomized Block Design, having seven (7) treatments with three (3) replications. The treatments consisted of Dry weed biomass mulch @ 5.0 tha^{-1} (T_{1}), Paddy straw mulch @ 5.0 t ha^{-1} (T_2), FYM Mulch @ 5.0 t ha^{-1} (T_3), Hoeing (Twice) 20 and 35 DAS (T_4), Hand weeding (twice) at 20 and 35 DAS (T_5) Hand weeding at 20 DAS and Hoeing at 35 DAS (T_6) and Unweeded control (T_7).

Different weed flora present in the experimental field was identified and their sequence of appearance, emergence profile and special characteristic feature were also noted by regular survey on weeds throughout the growing period of the crop. The results with the objective of studying the ecofriendly and alternative weed management practices over weeds of buckwheat were analyzed taking consideration of parameters like total weed populations, total dry weight of weeds, weed control efficiency and yield components and yield.

Weed Control Efficiency

Weed control efficiency (WCE) of the different treatments at different DAS was obtained by using the following formula.

$$WCE = \frac{\text{Dry matter of weeds in control plot (weedy situation)} - \text{Dry matter of weeds in treated plot}}{\text{Dry matter of weeds in control plot (weedy situation)}} \times 100$$

Statistical Analysis & Interpretation of Results

The date collected from the field and laboratory was analyzed statistically and the treatment variation was listed

for significance by F test (Cochran & Cox, 1955; Gomez & Gomez, 1983). The standard errors of mean and critical difference at 5% level are indicated in all the tables given. For determination of critical differences at 5% level of significance, Fisher & Yates (1963) table were consulted.

RESULTS AND DISSCUSSIONS

Different weed flora present in the experimental field was identified. Their sequence of appearance, emergence profile and special characteristic feature were also noted by regular survey on weeds throughout the growing period of the crop. Major grassy weeds in the experimental field were *Cynodon dactylon, Setaria glauca* and *Pasplium sp.* Whereas among the broadleaved weeds several species of *Polygonum* like *Polygonum persicaria, P. pensylvanicum* & *P. orientale* and *Stellaria media, Chenopodium album, Ageratum conyzoides, Euphorbia hirta, Amaranthus sp. and Vicia sativa* sedges like *Cyperus sp* were predominant. Among these weeds *Cynodon dactylon* and *Polygonum* appeared in the field with high invasion; however it became predominant during flowering and cyme development.

Effect of Treatments on Total Weed Population

The total population of weeds per metre square revealed that the weed population went on increasing till the last observation recorded at harvest, irrespective of the years of observation (Table 1). The rate of increase in weed population per meter square was the highest in Dry weed biomass mulch @ 5.0 t ha^{-1}(T_1) during the period of 30-60 days after sowing. Both initial weed population per unit area and weed population per meter square throughout the period of crop growth were very high in unweeded control (T_7) during both the years of investigation indicating greater weed crop competition from the early stage of crop growth. Irrespective of the year of investigation hand weeding twice (T_5) recorded the lowest number of total weeds per unit area. This might be due to removal of weed flushes at 20 & 35 days after sowing of the crop and hand weeding is very effective against annuals, biennials and controls only upper portions of perennials. Veeraputhiran (2009) reported that hand weeding twice gave lesser weed population in Blackgram and greengram compared to the other treatments. Among the mulch treatments, Dry weed biomass mulch @ 5.0 t ha^{-1} (T_1) followed by Paddy straw mulch @ 5.0 t ha^{-1} (T_2) gave the best performance at early stages of crop growth and FYM Mulch @ 5.0 t ha^{-1} (T_3) gave efficient weed control and recorded almost similar efficiency to that of hand weeding twice (T_5). Hoeing twice at 20 & 35 DAS (T_4) appreciably reduced the total weed population per metre square and it is more effective on annuals and biennials as weed growth can be completely destroyed and it also destroyed the top growth with little effect on underground plant parts resulting in re-growth than unweeded control plot (T_7) at all the stages of crop growth (Table 1).

Effect of Treatments on Total Dry Weight of Weeds (g m^{-2})

The effect of treatment on total dry weight of weeds gram per metre square have been presented in Table 2. In general, under corresponding treatments on total dry weight of weeds per unit area recorded lesser value at any particular stages of crop growth during the second year of the trial compared to that of the first year trial (Table 2). The total dry weight of weeds per metre square went on increasing with increase in age of weeds. Total dry weight of weeds per unit area at any particular stage of crop growth was always higher under unweeded control (T_7). This indicated that unabated growth of weeds in unweeded control resulted in higher dry matter accumulation (DMA). Hand weeding twice at 20 & 35 DAS (T_5) was recorded much lower throughout the period during both the years of investigation and was significantly superior to all other treatments. The reduction in dry weed biomass in hand weeded plots may be due to poor regeneration after removal of weed, while in weedy check plot weeds flourished throughout the season which resulted in greater weed

biomass. Zubair et al (2009) reported that hand weeding effectively reduced the total dry weed biomass in onion. Among the mulch treatment FYM @ 5.0 t ha^{-1} (T_3) very much appreciable to reduce the total dry weight of weeds per unit area compared to the other mulch treatment Dry weed biomass mulch @5.0 t ha^{-1} (T_1) and Paddy straw mulch @ 5.0 t ha^{-1} (T_2). Hashim et al (2013) also reported the mulching treatment significantly effect on dry weed biomass and the highest dry weed biomass was recorded in weedy check in maize. Barnes and Putnam (1983) reported that rye residue used as mulch reduced total weed biomass by 63%. Among these treatments Hand weeding at 20 DAS and Hoeing at 35 DAS (T_6) gave the best performance in this regards during both the years of investigation. Lesser total dry weight of weeds per metre square in this treatment was not only due to lesser number of weeds per unit area but also removal of biennial and annual weeds at 20 DAS by hand weeding and Hoeing at 35 DAS (T_6). Hoeing twice at 20 & 35 DAS (T_4) appreciably reduced the total dry weight of weeds than unweeded control plot (T_7) at all the stages of crop growth during both the years of investigation.

Effect of Treatments on Weed Control Efficiency

Among the different methods of weed control practices, the highest weed control efficiency was obtained under hand weeding (T_5) and similar trend on weed control efficiency was observed up to harvest of buckwheat (Table 3). At 30 DAS and 45 DASthe different weed control practices, significantly highest weed control efficiency was obtained in hand weeding twice (T_5) at 20 and 35 DAS followed by the FYM Mulch @ 5.0 t ha^{-1} (T_3), Hand weeding at 20 DAS and Hoeing at 35 DAS (T_6), Dry weed biomass mulch @ 5.0 t ha^{-1} (T_1) and Paddy straw mulch @ 5.0 t ha^{-1} (T_2). The Lowest weed control efficiency was recorded under hoeing twice at 20 and 35 DAS (T_4) sowing during 45 days after sowing.

At 60, 75 DAS and at harvest among the different methods of weed control practices the significantly highest weed control efficiency was recorded under hand weeding twice (T_5) followed by FYM Mulch @ 5.0 t ha^{-1} (T_3), hoeing twice at 20 and 35 DAS (T_4) and Hand weeding at 20 DAS and Hoeing at 35 DAS (T_6). Veeraputhiran (2009) reported that hand weeding twice 30 x 10 cm followed by mechanical weeding higher weed control efficiency in both green gram and black gram. Lowest value of weed control efficiency was recorded when Dry weed biomass mulch @ 5.0 t ha^{-1} (T_1) (Table 3).

Effect of Treatments on Yield Components and Yield of Buckwheat

The highest number of cymes per plant was recorded under hand weeding twice (T_5) followed by FYM Mulch @ 5.0 t ha^{-1} (T_3), Hand weeding at 20 DAS and Hoeing at 35 DAS (T_6) and hoeing twice at 20 & 35 DAS (T_4) at all the stages of crop growth during both the years of investigation (Table 4). This finding could be explained in the light of lesser weed-crop competition in these treatments which encouraged vegetative vigour and ultimately number of cymes per plant. Number of seeds per cyme recorded the lowest value in unweeded control plot (T_7) and highest number of seeds per cyme was recorded under hand weeding twice at 20 & 35 DAS (T_5) followed by FYM Mulch @ 5.0 t ha^{-1} (T_3), Hand weeding at 20 DAS and Hoeing at 35 DAS (T_6) and hoeing twice at 20 and 35 DAs (T_4) during both the years of investigation (Table 4). These findings were quite natural as weed- crop competition in T_5, T_3, T_6 and T_4 was much less from the initial stage of the crop growth to maturity compared to any other treatment tried in this investigation. Lesser weed- crop competition throughout the period of crop growth resulted in fullest manifestations of all the plant parts during each of the development phases of the plant and produced more number of cymes per plant and more number of seeds per cyme. Rana et al (2003) also reported that the seed yields of common buckwheat were positively correlated with straw yield and other yield contributing characters like number of cymes per plant, numbers of seeds per plant, plant density and plant height, but

negatively correlated with weed biomass.

Hand weeding twice (T_5) significantly recorded the highest test weight during both the years of investigation (Table 4). Unweeded control plot (T_7) showed the poorest performance with regard to test weight due to severe crop- weed competition from early stage of crop growth to maturity of the crop which adversely affect vegetative as well as reproductive vigour of plant and these was reflected on the test weight of seeds.

Effect of Treatments on Grain Yields, Stick Yield and Harvest Index of Buckwheat

The highest seed yield was recorded under hand weeding (twice) (T_5) in both the years of investigation (Table), this was closely followed by FYM Mulch @ 5.0 t ha^{-1} (T_3) and Hand weeding at 20 DAS and Hoeing at 35 DAS (T_6). The yield of buckwheat recorded lesser quantity of seed per hectare. Yield attributing characters like number of cymes per plant, number of seeds per cyme and test weight (Table 4) were quite high in these treatments. Cumulative effect of all these has been reflected on the seed yield of the crop. Paddy straw mulch @5.0 t ha^{-1} (T_2) produced high seed yield than Dry weed biomass mulch @5.0 tha^{-1} (T_1). Hoeing twice at 20 and 35 DAS (T_4) recorded higher seed yield than the treatment when applied alone (T_1 and T_2). The lowest seed yield of buckwheat was recorded under unweeded control (T_7) during both the years of experimentation (Table 5). Veeraputhiran (2009) also reported that the highest grain yields were registered by hand weeding twice followed by mechanical weeding (hoeing) in green gram and black gram.

The buckwheat stem yield was influenced by the different weed control practices. The maximum stem yield was obtained under hand weeding twice (T_5) followed by FYM Mulch @ 5.0 t ha^{-1} (T_3), Hand weeding at 20 DAS and Hoeing at 35 DAS (T_6) and hoeing twice (T_4). Dry weed biomass mulch @ 5.0 t ha^{-1} (T_1) and Paddy straw mulch @ 5.0 t ha^{-1} (T_2) when applied alone gave higher stem yield over unweeded control. The lowest value of stem yield was recorded under unweeded control (T_7). While in hand weeding (twice), mulch and hoeing was effectively increased green area of the crop due to proper weed management, as a result there might be more photosynthesis process and less crop-weeds competition for nutrient, moisture and space which automatically increased stem yield. Similar results were reported by Nawab et al., (1997) and Kwabiah (2003) in maize.

The statistical analysis of the data indicated that different mulching treatments have significant effect on harvest index (Table 5). The data showed that maximum harvest index was recorded hand weeding (twice) (T_5) followed by FYM Mulch @ 5.0 t ha^{-1} (T_3), Hand weeding at 20 DAS and Hoeing at 35 DAS (T_6) and hoeing twice at 20 &35 DAS (T_4). Dry weed biomass mulch @ 5.0 t ha^{-1} (T_1) and Paddy straw mulch @ 5.0 t ha^{-1} also (T_2) significantly recorded highest HI over control. The lowest HI was recorded under unweeded control. Saeed *et al*., (2010) also reported that maximum harvest index in less weed-infested plots in maize.

CONCLUSIONS

From the study it was concluded that different weed management practices, it is necessary to cover the soil surface with different mulching materials and manually weed (hand weeding and hoeing) control practices to achieve a good control of weeds and significantly influenced all the agronomic parameters which ultimately enhanced the yield attributes and yield. Hence, it is environmentally sound, socially acceptable and economically viable.

REFERENCES

1. Altieri, M.A. and Letourneau, D.K., 1982. Vegetation Management and Biological Control in Agro-Ecosystem: Ecological Approaches. Pp. 1-6.
2. Anderson, C., H. Stryhn and J.C. Streibig., 1996. Decline of the flora in the Danish arable fields. J. Appl. Ecol., 33(3): 619-626.
3. Barnes, J.P., Putnam, A.R., 1983. Rye residues contribute to weed suppression in no– tillage cropping systems. J. Chem. Ecol. 9, 1045–1057.
4. Campbell C.G., 1997. Buckwheat *Fagopyrum esculentum* Moench. International Plant Genetic Resources Institute, CAB International.
5. Cochran, G.W. and Cox, M.G. *Experimental Designs*. John Wiley and Sons. Inc. USA., 1955.
6. Cousens, R., and Mortimer, M. 1995., Dynamics of Weed Populations. Cambridge University Press, Cambridge.
7. Fisher, Sir Ronald A. and Yates, Frank., 1963. Statistical Tables for Biological, Agricultural and Medical Research. Sixth Edition. Oliver and Boyed. Fdiburgh Tweedal Court, London.
8. Gomez, A.K. and Gomez, A. A., 1983Statistical Procedures of Agricultural Research. An IRRI Book, John Wiley and Sons, New York.
9. Hallberg G. R., 1989. Pesticide pollution of ground water in the humid United States. Agric. Ecosyst. Environ. 26, 299–367.
10. Holt J. S. and LeBaron H. N., 1990. Significance and distribution of herbicide resistance. Weed Technol.4, 141-149.
11. Kluepfel, M., 2010. http://www.savvygardener.com/ Features/mulch.html.
12. Kreft I., Srabanja V., Ikeda S., Ikeda K., Bonafaccia G., 1996. Dietary value of buckwheat. Research Reports Biotechnical Faculty of the University of Lubljana, 67: 73–78.
13. Kwabiah, A.B., 2003. Performance of silage corn (Zea mays L.) in a cool climate ecosystem. Effects of photodegradable plastic mulch. Can. J. Plant Sci., 83(2): 305-312.
14. Lybecker D. W., Schweizer E. E. and King R. P., 1988. Economic analysis of four weeds management systems. Weed Sci. 36, 846–849.
15. Nawab, K., M. Hatam. H.D. Wadan and I.H. Khalil., 1997. Effect of time of weeding and plant spacing on growth and grain yield of maize. Sarhad J. Agric., 13(1): 55-60.
16. R. Veeraputhiran., 2009. Effect of mechanical weeding on weed infestation and yield of irrigated black gram and green gram. *Indian Journal of Weed Science* 41(1&2): 75-77.
17. Rana, S.S., K.K. Mondal, P. Sood and Rajinder Pal., 2003. A preliminary study on the herbicidal weed control in buckwheat. *Fagopyrum.* 20: 81- 84.
18. Saeed, M., K.B. Marwat, G. Hassan, and A. Khan., 2010. Interference of horse purslane with maize at different

densities. *Pak. J. Bot*., 42(1): 173-179.

19. Saima Hashim, Khan Bahadar Marwat, Muhammad Saeed, Muhammad Haroon, Muhammad Waqas and Shahfahad., 2013. Developing a Sustainable and Eco-Friendly Weed Management System Using Organic and Inorganic Mulching Techniques Pak. J. Bot., 45(2): 483-486.

20. Shah, P., K.R. Dahal, S.K. Shah and D.R. Dangol., 2011. Weed proliferation as affected by long-term tillage, mulch and time of nitrogen application in wheat (*Triticum aestivum* L.). Intl. Res. J. Appl. Basic. Sci., 2(2): 65-72.

21. Shaw, W. C. 1982. *Weed Science Suppl.* 30:2-12.

22. Singh H. P., Batish D. R. and Kohli R.K., 2003. Allelopathic interactions and allelo- chemicals: New possibilities for sustainable weed management. Critical Reviews in Plant Sciences. 22: 239-311.

23. Zubair, M., H.U. Rehman, M.S. Jilani, M. Kiran, M.K. Waseem, A.M. Khattak, A. Rahim, A.A. Khan, A. Qayyum and A. Wahab., 2009. Comparison of different weed management practices in onion (Allium cepa L.) under different climatic conditions of Dera Ismail Khan, Pakistan. Pak. J. Weed Sci. Res., 15(1): 45-51.

Table 1: Effect of Treatments on Total Weeds Population at Different Stages of Buckwheat

Treatment	Total Weeds Population (m^{-2})									
	Days After Sowing (DAS)									
	30		45		60		75		At harvest	
	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
T_1	**18.00**	18.33	**44.66**	44.33	**64.00**	61.86	**73.66**	70.16	**84.66**	80.60
T_2	**10.93**	8.57	**33.90**	30.60	**54.33**	50.63	**62.29**	60.33	**76.46**	72.66
T_3	**17.36**	16.90	**24.33**	22.33	**29.33**	27.66	**38.66**	35.33	**54.33**	50.00
T_4	**21.66**	20.08	**32.60**	38.33	**43.33**	40.76	**51.32**	48.00	**64.33**	61.66
T_5	**12.33**	10.03	**14.86**	12.90	**20.30**	18.66	**23.33**	20.33	**36.66**	29.00
T_6	**19.00**	18.46	**21.66**	20.03	**33.00**	31.33	**47.66**	44.80	**66.00**	64.36
T_7	**45.82**	40.66	**71.33**	64.33	**106.6**	101.0	**124.8**	120.5	**140.3**	135.3
S.E m (±)	**0.59**	0.37	**0.80**	0.50	**2.29**	0.46	**0.72**	0.46	**0.69**	0.71
C. D (P=0.05)	**1.83**	1.16	**2.47**	1.54	**7.07**	1.42	**2.24**	1.41	**2.11**	2.19

Y_1 = 2011-2012 and Y_2 = 2012-2013

Table 2: Effect of Treatments on Dry Weight of Total Weeds

Total Dry Weight (g m^{-2})									
Days After Sowing (DAS)									
30		45		60		75		At harvest	
Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
6.17	5.58	**11.38**	10.95	**22.33**	20.33	**30.83**	28.83	**38.00**	35.83
5.25	4.12	**10.26**	9.22	**20.78**	18.94	**28.73**	26.73	**34.15**	31.97
6.42	5.23	**4.71**	3.80	**11.53**	10.69	**19.76**	18.85	**24.06**	22.67
6.70	5.76	**12.55**	11.61	**17.51**	16.43	**25.73**	23.18	**31.87**	28.15
1.26	2.09	**3.28**	2.46	**8.25**	7.89	**12.07**	10.24	**17.09**	15.70
4.73	3.65	**10.39**	8.83	**18.20**	17.89	**23.56**	22.95	**27.37**	26.70
22.82	21.57	**35.56**	33.62	**50.96**	48.76	**60.99**	57.78	**75.29**	69.96
0.17	0.35	**0.08**	0.45	**0.04**	0.64	**0.04**	0.63	**0.03**	0.65
0.51	1.08	**0.26**	1.40	**0.12**	1.98	**0.11**	1.94	**0.9**	2.01

Y_1 = 2011-2012 and Y_2 = 2012-2013.

Table 3: Effect of Treatments on Weed Control Efficiency of Buckwheat

Treatment	Weed Control Efficiency (%) Days After Sowing (DAS)									
	30		45		60		75		At harvest	
	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
T_1	72.96	74.09	68.00	67.39	54.94	61.25	49.45	50.01	49.00	48.78
T_2	76.99	80.92	71.15	72.57	59.22	61.19	52.90	53.71	54.64	54.30
T_3	71.88	73.73	86.78	88.49	77.37	78.09	67.60	67.33	68.04	67.58
T_4	70.63	73.32	64.71	65.53	65.64	66.22	57.81	52.87	57.67	59.75
T_5	94.48	95.78	90.91	96.63	83.81	84.58	80.21	74.84	77.30	77.55
T_6	79.27	83.07	70.78	73.72	64.29	63.27	61.37	60.48	63.65	62.25
T_7	-	-	-	-	-	-	-	-	-	-
S.E m (±)	0.70	1.48	0.24	1.23	0.06	1.45	0.04	2.87	0.04	0.88
C. D(P=0.05)	2.15	4.58	0.73	3.79	0.20	4.46	0.11	8.86	0.12	2.72

Y_1 = 2011-2012 and Y_2 = 2012-2013.

Table 4: Effect of Treatments of Yield Attributes of Buckwheat

Treatment	No. of Cymes Plant^{-1}		No. of seeds cyme^{-1}		1000 Seed Weight (g)	
	Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
T_1	31.88	32.15	7.67	7.99	19.29	19.53
T_2	32.09	32.38	8.00	8.33	20.05	20.32
T_3	34.66	35.96	10.60	10.66	22.64	22.91
T_4	33.34	33.66	8.33	8.67	20.77	20.97
T_5	37.20	42.38	11.33	12.00	23.65	23.81
T_6	34.39	35.11	9.67	10.33	21.44	21.85
T_7	23.55	25.19	7.00	7.33	17.04	17.08
S.E m (±)	1.77	0.60	0.42	0.44	0.34	0.29
C. D. (P = 0.05)	5.45	1.85	1.31	1.36	1.04	0.88

Y_1 = 2011-2012 and Y_2 = 2012-2013.

Table 5: Effect of Treatments on Seed Yield, Stem Yield and Harvest Index

Seed Yield (q ha^{-1})		Stem Yield (q ha^{-1})		Harvest Index	
Y_1	Y_2	Y_1	Y_2	Y_1	Y_2
6.27	7.12	13.00	14.23	32.93	33.35
7.16	7.98	14.53	15.42	33.01	34.10
8.85	9.42	15.65	16.25	35.82	35.81
7.80	8.08	14.88	16.15	34.04	34.88
9.62	10.49	16.00	17.06	38.60	39.13
8.39	8.97	15.05	16.05	34.90	35.22
5.00	5.25	12.79	13.00	28.10	28.76
0.10	0.11	0.37	0.16	0.14	0.28
0.31	0.34	1.13	0.50	0.44	0.87

Y_1 = 2011-2012 and Y_2 = 2012-2013